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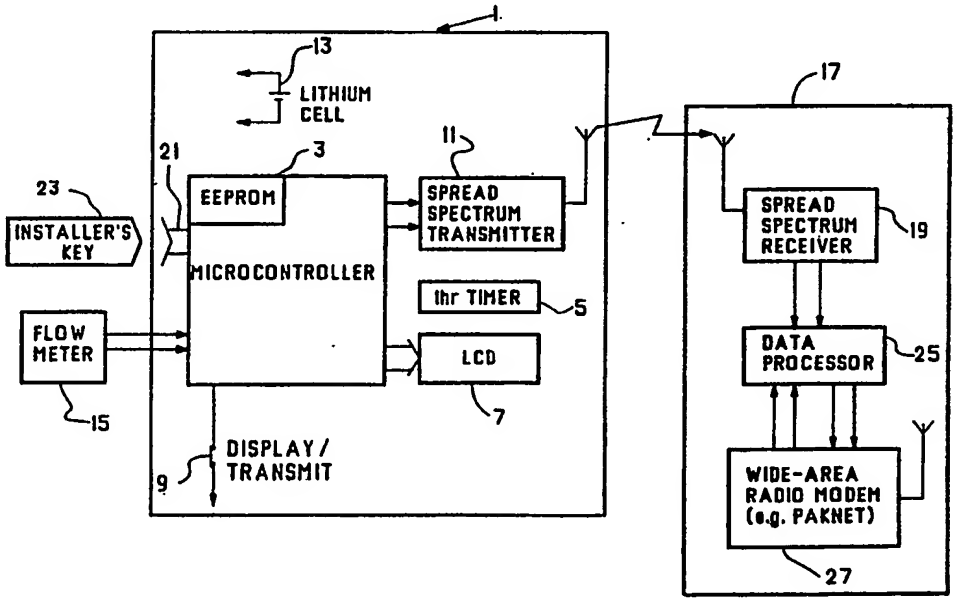
(54) Title: DATA GATHERING SYSTEM




(57) Abstract

A system for collecting, storing and transmitting data from a plurality of data generating units (15), comprising automatic data reading means (1) connected to each of said plurality of data generating units for receiving and storing data received from respectives ones of said plurality of data generating units and in response periodically transmitting said data together with a unique identification code; and area data collection means (17) for receiving, storing and periodically re-transmitting said data and said unique identification code from respective ones of said automatic data reading means in collective groupings.

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# DATA GATHERING SYSTEM

## Field of the Invention

The present invention relates in general to data gathering systems and more particularly to a system for gathering data on utility meter readouts.

## Background of the Invention

Various schemes are known for collecting data from utility meters. For example, U.S. Patent Nos. 4,031,513 (Simciak) and 4,799,059 (Gindahl) disclose radio frequency systems by which a mobile transmitter generates an RF interrogation signal to respective remote transponders connected to utility meters. In response, the transponders generate data concerning power usage, water usage, etc., for reception by the mobile interrogator. U.S. Patent 4,213,119 (Ward et al) discloses a remote meter reading system which operates using an electro-optical link.

One aspect of these prior art approaches is that an interrogator is required to initiate transmission of data concerning utility meter status. This contributes to high costs and levels of complexity in implementing such prior art systems. These prior art systems also teach that the transponders are maintained fully powered at all times.

## Summary of the Invention

According to the present invention, a plurality of RF transmitters are located in residential or industrial sites, each transmitter having inputs for receiving data from the utility meters (e.g. water, power, etc.) and transmitting the data received from the utility meters to a central data collection unit at predetermined time intervals.

The system of the present invention is primarily applicable to domestic dwellings, where there are a very large number of meters to be read, but the proposed system is not limited to this particular application and may equally well be used in industrial applications, or

indeed, in any situation where it is required to collect data infrequently and from remote sites without visiting those sites.

Thus, although the preferred embodiment relates to an application of the present invention to remote reading of domestic utility meters, the system in its broader aspects may be applied to numerous other data gathering problems. For example, the system of the present invention may be used for counting of vehicles at road intersections for the purpose of flow monitoring and traffic management.

Brief Description of the Drawings

A description of the preferred embodiment is provided herein below with reference to the following drawings, in which:

Figure 1 is a block diagram of the system of the present invention; and

Figure 2 is a detailed block diagram of a central data collection unit according to the preferred embodiment.

Detailed Description of the Preferred Embodiment

The system comprises a meter monitoring module (MMU) 1 having a microprocessor or microcontroller 3, a timer 5, a liquid crystal display 7, a push button 9, a spread spectrum (SS) transmitter 11 and power source in the form of lithium cell 13.

A flow monitoring unit (FMU) 15 provides data to the MMU 1, as will be described in greater detail below. One contemplated embodiment of the FMU 15 incorporates a passive sensor comprising a permanent magnet mounted to the fly wheel of an electric power meter, gas meter or the like, in combination with a read switch which may be actuated upon each passing rotation of the magnet, such that the number of rotations of the fly wheel may be counted and furnished to the MMU 1.

Pulses are delivered to the MMU 1 from the FMU 15. The manner in which these pulses are derived is of no

consequence to the MMU 1; an active source may be employed, such as a shaft encoder/decoder or a Hall effect transducer, but more commonly the above-discussed simple reed switch and permanent magnet will be utilized. One example of a suitable system is disclosed in U.S. Patent 4,315,248 (Ward). The interval between pulses is long in computing terms (one pulse every 10 to 20 seconds in the case of a gas flow meter), and the actual interval is irrelevant to operation of the MMU 1. The modular approach to the system provides that the same design of MMU 1 can be fed with pulses from gas, electricity or water meters or for counting the passage of vehicles in a traffic application. Between pulses, the MMU 1 is in a quiescent state, consuming least power from the lithium cell 13. Use of inexpensive commercially available lithium cells (lithium thionyl chloride chemistry), results in an operational life in excess of 10 years from one cell.

The MMU 1 accumulates the count of pulses received. This count is stored in $E^2$PROM of the microprocessor 3 for reliability. The consumer is charged for consumption on the basis of the accumulating count, so the data must be stored in a non-volatile manner. Battery backed-up RAM can be used as a suitable storage medium but in view of the importance of the information held in the storage device (accumulated consumption of gas, for example), battery backed-up RAM offers a lower integrity of data storage than $E^2$PROM

A characteristic of $E^2$PROM is that each location may only be written to a limited number of times (unlike RAM). Typically the write cycle endurance (number of write cycles to a particular location before the retention characteristics of the memory, in the absence of power, cannot be guaranteed) will be of the order of $10^4$ to $10^6$. A count of $10^4$ pulses might accumulate surprisingly quickly, dependent on the rate of flow being monitored and hence the interval between pulses from the

FMU 15. Therefore, the microprocessor 3 in the MMU 1 inspects the accumulating count every time a pulse is received. If the number of pulses accumulated exceeds a limit ($10^4$, say), then the block of data representing the accumulated count is moved one location further up in terms of the memory addressing. Hence, the location which has been written to $10^4$ times (the least significant digit of the count) will not be written to again, and thus the integrity of the stored count can be assured.

The timer 5 provides a further input to the microprocessor 3. The timer delivers pulses (interrupts) approximately once every hour. This is used to permit the MMU 1 to perform housekeeping operations. By design, the one hour timer 5 is not a close tolerance timer. It is designed to be sensitive to variations in temperature and component tolerance and ageing, resulting in a timer interval which may vary by ±10% of its nominal value. This variation will result in a relative shift between timer output pulses occurring at different meters. This variation offers a convenient means of varying the times at which a plurality of MMUs 1 will transmit their stored data. Alternatively timer 5 may be an integral part of microcontroller 3 and although the timer may then be referenced to an accurate time base such as the microcontroller's crystal controlled clock, an algorithm could be employed to process periodic timer interrupts in order to produce the same effect of timing drift that would be observed with an imprecise external timer.

At regular predetermined intervals, each MMU 1 transmits its stored data. This may occur as a result of a timer pulse being received and causing a transmit interval timer to overflow. A data packet from the MMU 1 comprises a unique identification number for the MMU (that identification number being installed in the MMU's $E^2$PROM during manufacture and being unalterable), the accumulated count (metered units), some control/status flags, and error check bits.

Transmission will occur very infrequently; for example, in the case of a domestic gas meter, one transmission cycle every week would be quite adequate. The MMU 1 preferably transmits a data packet several times, with a pseudo-randomly varying interval between transmissions. The varying interval, coupled with the inherent drift in timer intervals between meters allows for a large number of meters to make use of a single transmission channel.

Data is transmitted from each MMU 1 via SS transmitter 11. A spread spectrum transmitter 11 (and receiver 19 in the DCU) is proposed as this method of RF transmission is inherently substantially immune to interference. The immune characteristic of SS is an important benefit of the present system, since the nature of signals which could potentially interfere with the desired transmissions will vary widely. A further advantage accruing from the use of SS techniques is that it is very difficult to monitor SS transmissions other than with a receiver matched to the transmitter, and furthermore it is difficult to simulate such transmissions without an appropriate encoder and transmitter. These difficulties result in a relatively secure system thereby minimizing the risk of fraud.

A further advantage accrued from the use of spread spectrum radio technology is the immunity of the system from fading. Fading is the term used to describe a reduction in signal strength of a narrow band signal due to environmental conditions which affect the propagational characteristics of radio waves. For example, consider a stationary vehicle with a VHF FM radio tuned to a particular frequency (station), and from time to time large vehicle pass by the stationary one. It is commonly observed that under these circumstances the received signal will be distorted as the propagation path between transmitter and receiver has been modified by the transient presence of a passing vehicle. Problems

of fading are significantly reduced through the use of spread spectrum radio transmission, so consequently in this application things which effect the nature of the propagation path between MMUs and DCUs will have drastically less detrimental effect on the performance of this system compared with a similar system which employed narrow band radio signals.

The spread spectrum transmitter 11 (and SS receiver 19 in Figure 2) may be operated in accordance with the principles disclosed in U.S. Patent 4,977,577 (Arthur et al)

It is possible for the MMU 1 to transmit at times other than when the routine transmission interval timer 5 overflows. For example, the MMU 1 may be provided with an output which monitors a tamper circuit (not shown), and a special transmission could be produced to alert the monitoring system to this event.

It is possible for the MMU 1 to be directed to display the stored accumulated count. For reasons of power economy, the LCD 7 is not driven at all times, but only on demand. Legislation currently dictates that the consumer must be able to "read" his usage of gas (for example), but since a demand is likely to be infrequent, there is no need to display this information permanently. The MMU 1 is provided with a push button 9, depression of which causes the microprocessor 3 to present information on the display.

For maintenance of the system, the MMU 1 includes a connector 21 for a device 23 such as a hand held terminal. Facilities are provided to allow the MMU 1 to be directed to perform tasks such as transmitting on demand to the nearby DCU 17, thus enabling the complete data collection system to be exercised. The remainder of the system works in the following manner.

The DCU 17 comprises SS receiver 19 and a data processor 25. Signals detected by the SS receiver 19 are processed, and those originating from MMUs 1 which are

free of errors are held ready for onward transmission to a central data gathering computer (not shown) via a wide-area radio modem 27 connected to the data processor 25. The DCU 17 is a flexible and powerful unit relative to the MMU 1, capable of storing readings captured from up to 1,000 MMUs ready for onward transmission. The DCU 17 can be configured to transmit data in convenient packet sizes, dependent on the chosen DCU 17 to central computer link, and, if appropriate, the DCU can be directed to use the communications channel at particular times of the day in order to take advantage of the preferential discount rates, etc.

The specific type of link between the DCU 17 and the central computer (not shown) is not critical. Practical examples of communications links between DCUs and the central computer are PAKNET, which is a dedicated, deterministic packet-switching RF communications network, or PSTN, and the cellular radio network. It may well be that in some applications the service providers will already have an existing RF communications network over which the meter readings could be gathered.

Turning briefly to Figure 2, the data processor 25 of DCU 17 is shown in greater detail comprising a microprocessor or central processing unit (CPU) 31, memory in the form of ROM 33, RAM 35 and $E^2$PROM 37 connected to the CPU 31 via data bus 39 and address bus 41, in a well known manner, and a watchdog circuit 43 for supervising the operation of the CPU 31 and providing power management functions using well known methods. Control logic is not shown, for clarity of representation. The CPU 31 is driven by a first crystal referenced clock 45 and has a further real time clock 47, with back-up battery 49, connected thereto as a peripheral for controlling the timing of transmissions from the DCU 17 to the central host computer via modem 27, so that the DCU has knowledge of the time of day, so

that it can for example time stamp messages received from MMUs and messages transmitted to the host computer, and for reference so that the DCU may transmit packets of information to the host computer at set times. The modem 27 is connected to CPU 31 via serial line drivers and receivers 51, also in a well known manner.

The preferred embodiment data processor 25 shown in Figure 2 is also applicable to the design of microcontroller 3 in Figure 1.

In summary, according to the present invention, a data gathering system is provided wherein the data gathering process is completely automated, requiring no human action or intervention. The system of the present invention offers a meter monitoring unit (MMU 1) which is very simple, and thus presents a low cost solution to the problem of remote data gathering. The MMU 1 may be battery powered and therefore does not require connection to power mains supply at the domestic (or industrial) location. Since the MMU 1 does not need to be "active" other than in response to events delivered by the FMU 15, the MMU features exceptionally low quiescent power consumption thus offering extended service life between changes of battery 13. Use of spread spectrum radio frequency transmissions results in reliability of this system that is greatly improved compared with narrow band radio systems. Finally, a large number of sites/meters can be monitored by one data collection unit 17.

Other embodiments and variations of the invention are possible without departing from the sphere and scope as defined by the claims appended hereto.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OF PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A system for collecting, storing and transmitting data relating to utility consumption and other information from a plurality of utility meters or other flow or pulse counted devices, comprising:

a) automatic meter reading means connected to each of said plurality of utility meters for receiving and counting successive pulses of said data received from respective ones of said plurality of utility meters and in response generating a count value indicative of said utility consumption, and periodically transmitting said count value together with a unique identification code; and

b) area data collection means for receiving, storing and periodically re-transmitting said count value and said unique identification code from respective ones of said automatic meter reading means in collective groupings.

2. The system of claim 1, wherein each of said automatic meter reading means further comprises:

a) a microcontroller for counting said successive pulses of said data received from a respective one of said plurality of utility meters and in response generating said count value indicative of said utility consumption;

b) memory means incorporated in said microcontroller for storing said count value and said unique identification code;

c) a timer connected to or an integral part of said microcontroller for generating a succession of timing pulses after a predetermined number of which transmission of said count value and said unique identification code is initiated;

d) a spread spectrum transmitter connected to said microcontroller for transmitting said count value and said unique identification code stored in said memory means in response to generation of said predetermined number of timing pulses; and

e) wherein said microcontroller remains in a quiescent, low-power consumption state except during counting of said successive pulses and transmission of said count value and said unique identification code.

3. The system of 2, wherein said automatic meter reading means further comprises:

f) display means connected to said microcontroller for displaying said data corresponding to utility consumption on demand; and

g) a push-button switch connected to said microcontroller for initiating activation of said display means and displaying of said data corresponding to utility consumption in response to user activation of said switch.

4. The system of claim 2, wherein said automatic meter reading means further comprises battery means for providing operating power to said microcontroller, memory means, timer, spread spectrum transmitter and display means.

5. The system of claim 2, wherein said memory means is an $E^2PROM$, and wherein said microcontroller monitors said count value in said $E^2PROM$ upon receipt of each successive pulse and in the event said count value exceeds a predetermined amount indicative of the write cycle endurance of said $E^2PROM$ then re-storing said count value in a portion of said $E^2PROM$ which has not been previously addressed, thereby ensuring integrity of said count value stored within said $E^2PROM$.

6. The system of claim 2, wherein said timer generates said succession of timing pulses at a timing interval of approximately once every hour, and said predetermined number of timing pulses are generated approximately once per week.

7. The system of claim 6, wherein said timer is of low tolerance design such that said timing interval exhibits a variation of approximately ±10%, thereby contributing to reduce the probability that two or more successive transmission of said count value and said unique identification code from two of said automatic meter reading means will overlap in time.

8. The system of claim 1, wherein each said automatic meter reading means transmits said count value and said unique identification code a plurality of times in succession, with a pseudo-randomly varying interval between successive transmissions, thereby contributing to low probability of simultaneous transmission of said count value and said unique identification code by more than one of said automatic meter reading means.

9. The system of claim 1, wherein said area data collection means further comprises:

a) a spread spectrum receiver connected to said microcontroller for receiving said count value and said unique identification code from respective ones of said automatic meter reading means;

b) a microprocessor and associated memory means for storing said count value and said unique identification code from respective ones of said automatic meter reading means in said collective groupings;

c) a timer connected to said microprocessor and associated memory means for generating a succession of timing pulses after a predetermined number of which

transmission of said count value and said unique identification code from respective ones of said automatic meter reading means in said collective groupings is initiated; and

d) a wide-area modem connected to said microprocessor for transmitting said data and said unique identification code stored in said memory means in response to generation of said predetermined number of timing pulses.

10. A system for collecting, storing and transmitting data from a plurality of data generating units, comprising:

a) automatic data reading means connected to each of said plurality of data generating units for receiving and storing data received from respective ones of said plurality of data generating units and in response periodically transmitting said data together with a unique identification code; and

b) area data collection means for receiving, storing and periodically re-transmitting said data and said unique identification code from respective ones of said automatic data reading means in collective groupings.

11. The system of claim 10, wherein each of said automatic data reading means further comprises:

a) a microcontroller and memory means for receiving and storing said data and said unique identification code;

b) a timer connected to said microcontroller for generating a succession of timing pulses after a predetermined number of which transmission of said data and said unique identification code is initiated;

c) a spread spectrum transmitter connected to said microcontroller for transmitting said data and said unique identification code stored in said memory means in

response to generation of said predetermined number of timing pulses; and

d) wherein said microcontroller remains in a quiescent, low-power consumption state except during receiving, storing and transmission of said data and said unique identification code.

12. The system of 11, wherein said automatic data reading means further comprises:

e) display means connected to said microcontroller for displaying said data on demand; and

f) a push-button switch connected to said microcontroller for initiating activation of said display means and displaying of said data in response to user activation of said switch.

13. The system of claim 11, wherein said automatic data reading means further comprises battery means for providing operating power to said microcontroller, memory means, timer, spread spectrum transmitter and display means.

14. The system of claim 11, wherein said memory means is an $E^2PROM$, and wherein said microcontroller monitors said data in said $E^2PROM$ in the event said data exceeds a predetermined amount indicative of the write cycle endurance of said $E^2PROM$ then re-storing said data in a portion of said $E^2PROM$ which has not been previously addressed, thereby ensuring integrity of said data stored within said $E^2PROM$.

15. The system of claim 11, wherein said timer generates said succession of timing pulses at a timing interval of approximately once every hour, and said predetermined number of timing pulses are generated approximately once per week.

16. The system of claim 15, wherein said timer is of low tolerance design such that said timing interval exhibits a variation of approximately ±10%, thereby contributing to low probability of simultaneous transmission of said data and said unique identification code by more than one of said automatic data reading means.

17. The system of claim 10, wherein each said automatic data reading means transmits said data and said unique identification code a plurality of times in succession, with a pseudo-randomly varying interval between successive transmissions, thereby contributing to low probability of simultaneous transmission of said data and said unique identification code by more than one of said automatic data reading means.

18. The system of claim 10, wherein said area data collection means further comprises:

a) a spread spectrum receiver connected to said microcontroller for receiving said data and said unique identification code from respective ones of said automatic data reading means;

b) a microprocessor and associated memory means for storing said data and said unique identification code from respective ones of said automatic data reading means in said collective groupings;

c) a timer connected to said microprocessor and associated memory means for generating a succession of timing pulses after a predetermined number of which transmission of said data and said unique identification code from respective ones of said automatic data reading means in said collective groupings is initiated; and

d) a wide-area modem connected to said microprocessor for transmitting said data and said unique identification code stored in said memory means in

response to generation of said predetermined number of timing pulses.

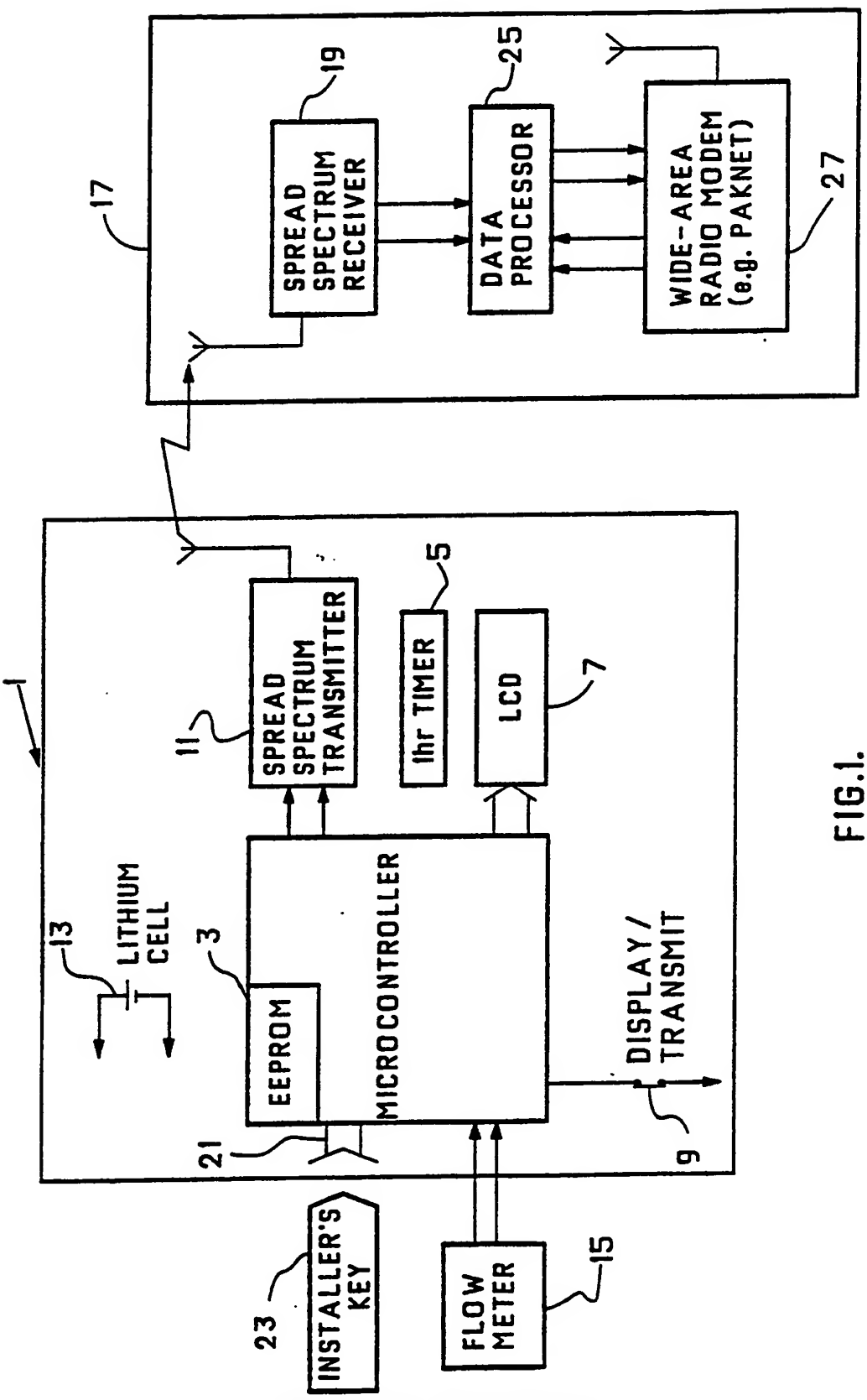
17
19
SPREAD SPECTRUM RECEIVER
25
DATA PROCESSOR
WIDE-AREA RADIO MODEM (e.g. PAKNET)
27
1
11
SPREAD SPECTRUM TRANSMITTER
5
1hr TIMER
LCD
7
13
LITHIUM CELL
3
EEPROM
MICROCONTROLLER
DISPLAY/ TRANSMIT
9
21
23
INSTALLER'S KEY
FLOW METER
15

FIG.1.

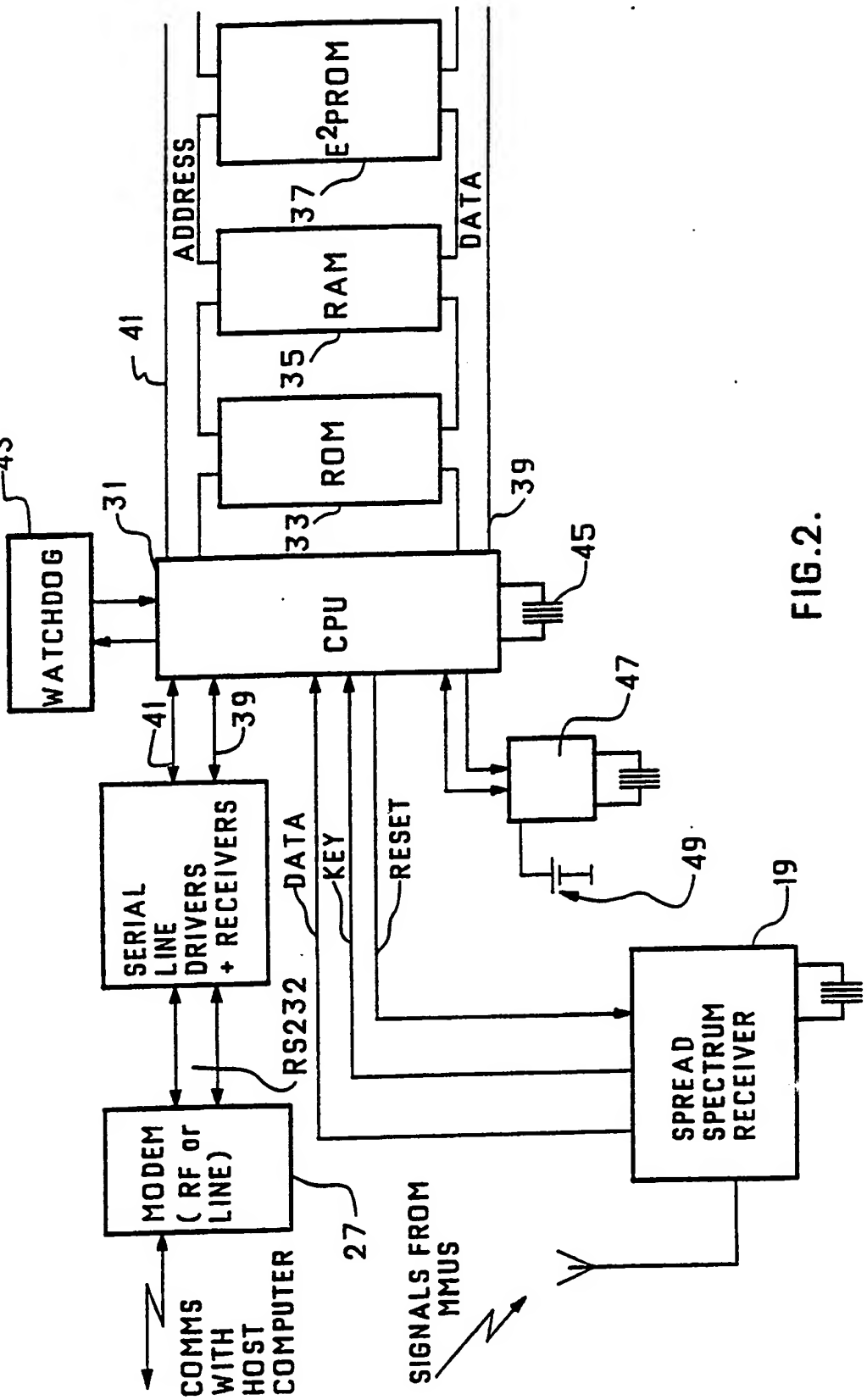
E2PROM
37
RAM
35
ROM
33
ADDRESS
DATA
41
39
43
31
WATCHDOG
CPU
45
47
49
SERIAL LINE DRIVERS + RECEIVERS
DATA
KEY
RESET
RS232
MODEM ( RF or LINE)
27
19
SPREAD SPECTRUM RECEIVER
COMMS WITH HOST COMPUTER
SIGNALS FROM MMUS

FIG.2.

# INTERNATIONAL SEARCH REPORT

International Application No PCT/CA 92/00363

## I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 G08C17/00

## II. FIELDS SEARCHED

Minimum Documentation Searched[7]

| Classification System | Classification Symbols |
|---|---|
| Int.Cl. 5 | G08C ; H04M ; H04Q ; G08B |

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

## III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

| Category ° | Citation of Document,[11] with indication, where appropriate, of the relevant passages[12] | Relevant to Claim No.[13] |
|---|---|---|
| Y | EP,A,0 317 082 (GENERAL INSTRUMENT CORPORATION) 24 May 1989 see column 2, line 34 - column 5, line 7; figures 1,2 --- | 1-4, 8-13,17, 18 |
| Y | IEEE TRANSACTIONS ON POWER DELIVERY vol. 2, no. 3, July 1987, NEW YORK US pages 671 - 676 J.T.LANCASTER ET AL 'SEMI-AUTOMATIC METER READING' see the whole document --- | 1-4, 8-13,17, 18 |
| Y | US,A,4 977 577 (ARTHUR ET AL) 11 December 1990 cited in the application see column 4, line 43 - column 12, line 33; figures 1,2,3B --- -/-- | 2,4,8,9, 13,17,18 |

° Special categories of cited documents :[10]

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## IV. CERTIFICATION

| Date of the Actual Completion of the International Search | Date of Mailing of this International Search Report |
|---|---|
| 12 OCTOBER 1992 | 28. 10. 92 |
| **International Searching Authority** | **Signature of Authorized Officer** |
| EUROPEAN PATENT OFFICE | WANZEELE R.J. |

Form PCT/ISA/210 (second sheet) (January 1985)

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

| Category ° | Citation of Document, with indication, where appropriate, of the relevant passages | Relevant to Claim No. |
|---|---|---|
| Y | DE,A,3 703 387 (GOSSEN GMBH)<br>27 August 1987<br>see claim 1<br>see column 13, line 38 - line 62; figure 7 | 3,12 |
| A | PROCEEDINGS IECON' 86, SEPTEMBER 29 -OCTOBER 3,1986. IEEE US<br>pages 327 - 332<br>M.PRAVDIC ET AL 'MICROCOMPUTER SYSTEM FOR PULSE DATA ACQUISITION, RECORDING, LOCAL PROCESSING AND REMOTE DATA TRANSMISSION'<br>see the whole document | 5,14 |
| A | GB,A,2 210 537 (SPACE AGE ELECTRONICS LIMITED)<br>7 June 1989<br>see abstract; figure 1 | 1,10 |

# ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. CA 9200363 SA 63411

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 12/10/92
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| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| EP-A-0317082 | 24-05-89 | AU-A- 2512788 | 25-05-89 |
| | | JP-A- 1166685 | 30-06-89 |
| | | US-A- 5081680 | 14-01-92 |
| US-A-4977577 | 11-12-90 | US-A- 5067136 | 19-11-91 |
| | | US-A- 5095493 | 10-03-92 |
| DE-A-3703387 | 27-08-87 | None | |
| GB-A-2210537 | 07-06-89 | None | |